mutual affinities of the "typical forms" of Foraminifera whose structure he has now elucidated; and he sums up the evidence which his examination of them has furnished in regard to the very wide range of variation which seems especially to characterize this group,—avowing his conviction that the only classification of it which can approach to a really natural arrangement, will be one founded upon the idea of "descent with modification" as the means by which an almost infinite variety of special forms has been evolved from a few fundamental types.

June 21, 1860.

Sir BENJAMIN C. BRODIE, Bart., President, in the Chair.

Frederick Augustus Abel, Esq., Thomas Baring, Esq., John Frederic Bateman, Esq., Edward Brown-Séquard, M.D., Richard Christopher Carrington, Esq., and Roundell Palmer, Esq., were admitted into the Society.

In accordance with notice given at the last Meeting, the Right Honourable George Augustus, Earl of Sheffield, was proposed for election and immediate ballot; and the ballot having been taken, his Lordship was declared duly elected.

The following communications were read:—

I. "Experimental Researches on various questions concerning Sensibility." By E. Brown-Séquard, M.D. Communicated by Dr. Sharpey, Sec. R.S. Received May 24, 1860.

The first question I propose to examine relates to the duration of sensibility in parts of the body completely deprived of the circulation of blood.

This question has hitherto received but little attention from physiologists. It is true that many experiments have been made to ascertain how long sensibility remains in animals in which circulation is stopped by the application of a ligature round the large blood-vessels of the heart; but I do not know of any special research upon the duration of sensibility in a nerve in which there is a suspension of

circulation. No doubt it has been occasionally observed, in experiments made with the view of ascertaining what effects are due to the ligature of the aorta, that sensibility persists in the nerves of the lower limbs much longer than irritability in the muscles, but no precise determination has been made of the exact duration of sensibility in such cases, except, to a certain extent, in some experiments of my own and those of Stannius. My researches, although giving an indication of the duration of sensibility in the lower limbs, had not been made with the special view of elucidating this question, their object being to decide whether the vital properties of muscles and nerves could be restored after having completely disappeared. The experiments of Stannius were made with the same view as mine. It may therefore be said that the subject of the present paper is almost entirely new, at least as regards warm-blooded animals.

A ligature round the aorta does not stop circulation completely enough to allow any positive conclusion regarding the duration of sensibility in nerves deprived of circulation of blood.

Desirous of avoiding the causes of error which exist when the aorta is tied, I have proceeded in the following manner:—I apply ligatures on the femoral artery, and after having divided this vessel between the ligatures, I amputate the thigh completely, excepting, however, that I leave the two large nerves of the limb undivided and as little injured as possible.

In experimenting in this way, I find—

1st. That the duration of sensibility in the toes, in Rabbits, varies between twenty and twenty-three minutes.

2nd. That, in Guinea-pigs, the duration varies between forty and fifty minutes. I have seen sensibility lasting a little more than an hour in one case.

3rd. That, in Dogs, the duration of sensibility varies between thirty and thirty-five minutes.

It is a very remarkable fact that the duration of sensibility varies so much in animals so nearly related to each other as Rabbits and Guinea-pigs.

The second question I propose to examine relates to the influence of temperature on the duration of sensibility in parts deprived of the circulation of blood. It has been erroneously assumed that vital properties last longer in parts submitted to a temperature similar to that

of the body, than in parts of which the temperature is very much lowered. I have experimented on almost completely amputated limbs of Guinea-pigs, as in the preceding instances. The limbs were placed in a vessel dipped into water at different temperatures. The results have been as follows :—

1st. Water at 104° Fahr. Duration of sensibility, in average forty-one minutes.

2nd. Water at 80° Fahr. Duration of sensibility forty-nine minutes.

3rd. Water at 50° Fahr. Duration of sensibility fifty-three minutes.

4th. Water at 35° Fahr. Duration of sensibility fifty-eight minutes.

These results, which will not surprise persons who know the laws of the influence of heat and cold on the vital properties of the spinal cord, of motor nerves and muscles, clearly show that the lower the temperature, the longer sensibility persists in parts deprived of circulation.

The third question I have tried to solve, is whether an augmentation in the vital properties of the spinal cord is able to influence the duration of sensibility in a limb deprived of the circulation of blood. It is known that when a transverse section is made upon the posterior surface of the spinal cord in a mammal, and especially in a rabbit, all the parts of the body which are behind the section become much more sensitive than they were previous to the operation. I have made two series of experiments to find out if, in cases of this kind, the duration of sensibility in parts deprived of circulation would be increased.

In one series of experiments I first divide the posterior columns of the spinal cord and then amputate all the parts of a hind limb except the nerves, while in another series I divide the spinal cord after having made the amputation. In both series I find that sensibility lasts notably longer than in animals in which the posterior columns have not been divided. For instance, in rabbits, instead of twenty or twenty-two minutes, sensibility lasts thirty or thirty-five minutes; and in one case I have seen it still persisting, though very weak, after thirty-eight minutes; I did not in this instance ascertain how long it lasted.

A very remarkable fact is that in a rabbit in which the spinal cord is in a normal condition, and in which the toes, after partial amputation as in the preceding experiments, are about losing the last appearance of sensibility, I find that there is a rapid and very notable return of this vital property if I divide the posterior columns of the spinal cord in the dorsal region. These experiments show that when sensibility seems to be lost in a part deprived of circulation, it is not completely so, but that the transmitted excitation which causes sensation is too slight to produce it, and that if in its way to the sensorium this excitation meets with a cause of increase, then sensation can be produced by it.

II. "On Quaternary Cubics." By the Rev. GEORGE SALMON. Communicated by ARTHUR CAYLEY, Esq. Received June 14, 1860.

(Abstract.)

In this paper quaternary cubics are discussed under the canonical form first given by Professor Sylvester,

$$ax^3+by^3+cz^3+du^3+ev^3,$$

where $x+y+z+u+v=0$.

The writer shows how, when quantics are thus expressed with a supernumerary variable, it is possible to form contravariants also expressed with a supernumerary variable, and such that for the variables, either in covariant or contravariant, we may substitute differentials with regard to the variables of the other. By the help of this principle, covariants, contravariants, and invariants of the cubic are formed with great facility. It is proved that a quaternary cubic has five fundamental invariants of the degrees respectively 8, 16, 24, 32, 40, as well as an invariant of the degree 100, whose square can be expressed in terms of the five fundamental invariants. The discriminant is also expressed in terms of the four first of these invariants. It is remarked that in the same manner as the theory of ternary cubics is analogous to the theory of binary quartics, so there are many analogies between the theory of quaternary cubics and that of binary quintics.

Four covariants are noticed of the first degree in the variables, by the aid of which expressions for the cubic can be obtained analogous